



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 10/646,897      | 08/22/2003  | Warren M. Farnworth  | 01-1059.1           | 1324             |

22823 7590 03/17/2008  
STEPHEN A GRATTON  
THE LAW OFFICE OF STEVE GRATTON  
2764 SOUTH BRAUN WAY  
LAKEWOOD, CO 80228

|          |
|----------|
| EXAMINER |
|----------|

LEWIS, MONICA

|          |              |
|----------|--------------|
| ART UNIT | PAPER NUMBER |
|----------|--------------|

2822

|           |               |
|-----------|---------------|
| MAIL DATE | DELIVERY MODE |
|-----------|---------------|

03/17/2008

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

|                              |                                      |   |  |
|------------------------------|--------------------------------------|---|--|
| <b>Office Action Summary</b> | <b>Application No.</b><br>10/646,897 | <b>Applicant(s)</b><br>FARNWORTH ET AL. |  |
|                              | <b>Examiner</b><br>MONICA LEWIS      | <b>Art Unit</b><br>2822                 |  |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 18 December 2007.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 170-179 and 262-271 is/are pending in the application.
- 4a) Of the above claim(s) 174 and 179 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 170-173, 175-178 and 262-271 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 April 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                       | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | Paper No(s)/Mail Date. _____                                      |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>12/07</u> .   | 6) <input type="checkbox"/> Other: _____                          |

### **DETAILED ACTION**

1. This office action is in response to the request for continued examination filed December 18, 2007.

#### ***Continued Examination Under 37 CFR 1.114***

2. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 12/18/07 has been entered.

#### ***Response to Arguments***

3. Applicant's arguments with respect to claims 170-173, 175-178 and 262-271 have been considered but are moot in view of the new ground(s) of rejection.

#### ***Specification***

4. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

#### ***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Art Unit: 2822

6. Claims 170, 172, 173, 175-178, 263, 265-267 and 270 are rejected under 35

U.S.C. 103(a) as obvious over Wakabayashi (U.S. Patent No. 6,607,970) in view of Farnworth et al. (U.S. Patent No. 6,620,731) and *Moisture Absorption in No-Flow Underfill Materials and its Effect on Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board* by Ferguson et al.

In regards to claim 170, Wakabayashi discloses the following:

a) a semiconductor die (1), circuit side, a back side, four peripheral edges, and a plurality of die contacts (2) on the circuit side (For Example: See Figure 15);

b) a plurality of contact bumps (5) on the die contacts (For Example: See Figure 15);

c) a first polymer layer (13) comprising a continuous layer covering the circuit side, the peripheral edges to the back side, the first polymer layer having a first planar surface on the circuit side and continuous edge polymer layers covering the peripheral edges (For Example: See Figure 15); and

d) a second polymer layer (17) covering the back side having a second planar surface, the first polymer layer and the second polymer layer encapsulating the die on six sides and supporting the die, the contact bumps and the peripheral edges (For Example: See Figure 15); and

e) a plurality of terminal contacts (6) on the contact bumps (For Example: See Figure 15).

In regards to claim 170, Wakabayashi fails to disclose the following:

a) a thinned die.

However, Farnworth et al. ("Farnworth") discloses a semiconductor device that has a thinned die (For Example: See Column 8 Lines 61-67). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Wakabayashi to include a thinned die as disclosed in Farnworth because it aids in exposing conductive members (For Example: See Column 8 Lines 61-67).

Additionally, since Wakabayashi and Farnworth are both from the same field of endeavor, the purpose disclosed by Farnworth would have been recognized in the pertinent art of Wakabayashi.

b) polymer is rigidifying.

However, Ferguson et al. ("Ferguson") discloses a semiconductor device where the polymer material is rigidifying (For Example: See Page 327). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Wakabayashi to include polymer material comprising a self planarizing thermoset underfill film which is rigidifying as disclosed in Ferguson because it aids in providing resistance to moisture (For Example: See Page 327).

Additionally, since Wakabayashi and Ferguson are both from the same field of endeavor, the purpose disclosed by Ferguson would have been recognized in the pertinent art of Wakabayashi.

c) the die having a selected thickness and the first polymer layer precise thickness and the second polymer layer having a precise thickness.

Wakabayashi discloses the claimed invention except for a semiconductor die having a selected thickness and the first polymer layer precise thickness and the second polymer layer having a precise thickness. It would have been obvious matter of design choice to provide a semiconductor die having a selected thickness and the first polymer layer precise thickness and the second polymer layer having a precise thickness, since such a modification would have a mere change in the size of a component. A change in size is generally recognized as being within the level of ordinary skill in the art. See *In re Rise*, 105 USPQ 237 (CCPA 1955).

Additionally, the applicant has not established the critical nature of “the die having a selected thickness and the first polymer layer precise thickness and the second polymer layer having a precise thickness.” “The law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims. . . . In such a situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range.” *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir.1990).

Finally, the following limitations make it a product by process claim:

a) “planarized;” and b) “rigidifying.” The MPEP § 2113, states, "Even though product -by[-] process claims are limited by and defined by the process, determination of patentability is based upon the product itself. The patentability of a product does not depend on its method of production. If the product in product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product is made by a different process." *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985)(citations omitted).

A "*product by process*" claim is directed to the product per se, no matter how actually made, *In re Hirao and Sato et al.*, 190 USPQ 15 at 17 (CCPA 1976) (footnote 3). See also *In re Brown and Saffer*, 173 USPQ 685 (CCPA 1972); *In re Luck and Gainer*, 177 USPQ 523 (CCPA 1973); *In re Fessmann*, 180 USPQ 324 (CCPA 1974); and *In re Marosi et al.*, 218 USPQ 289 (CAFC 1983) final product per se which must be determined in a "*product by, all of*" claim, and not the patentability of the process, and that an old or obvious product, whether claimed in "*product by process*" claims or not. Note that Applicant has the burden of proof in such cases, as the above caselaw makes clear.

In regards to claim 172, Wakabayashi fails to disclose the following:

- a) the first polymer layer comprises a thermoset underfill film.

However, Ferguson discloses a semiconductor device where the polymer material comprises a self planarizing thermoset underfill film which is rigidifying (For Example: See Page 327). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Wakabayashi to include polymer material comprising a self planarizing thermoset underfill film which is rigidifying as disclosed in Ferguson because it aids in providing resistance to moisture (For Example: See Page 327).

Additionally, since Wakabayashi and Ferguson are both from the same field of endeavor, the purpose disclosed by Ferguson would have been recognized in the pertinent art of Wakabayashi.

In regards to claim 173, Wakabayashi fails to disclose the following:

- a) the second polymer layer comprises a thermoset underfill film.

However, Ferguson discloses a semiconductor device where the polymer material comprising a thermoset underfill film (For Example: See Page 327). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Wakabayashi to include polymer material comprising thermoset underfill film as disclosed in Ferguson because it aids in providing resistance to moisture (For Example: See Page 327).

Additionally, since Wakabayashi and Ferguson are both from the same field of endeavor, the purpose disclosed by Ferguson would have been recognized in the pertinent art of Wakabayashi.

Art Unit: 2822

In regards to claims 175 and 270, Wakabayashi fails to disclose the following:

a) the underfill cures and planarizes at a temperature of about 200-250, has a Young's modulus of about 4G Pascal, and a coefficient of thermal expansion (CTE) of about 33 parts per million per C.

Finally, the following limitation makes it a product by process claim: a) "the underfill cures and planarizes at a temperature of about 200-250, has a Young's modulus of about 4G Pascal, and a coefficient of thermal expansion (CTE) of about 33 parts per million per C." The MPEP § 2113, states, "Even though product -by[-] process claims are limited by and defined by the process, determination of patentability is based upon the product itself. The patentability of a product does not depend on its method of production. If the product in product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product is made by a different process." *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985)(citations omitted).

A "product by process" claim is directed to the product per se, no matter how actually made, *In re Hirao and Sato et al.*, 190 USPQ 15 at 17 (CCPA 1976) (footnote 3). See also *In re Brown and Saffer*, 173 USPQ 685 (CCPA 1972); *In re Luck and Gainer*, 177 USPQ 523 (CCPA 1973); *In re Fessmann*, 180 USPQ 324 (CCPA 1974); and *In re Marosi et al.*, 218 USPQ 289 (CAFC 1983) final product per se which must be determined in a "product by, all of" claim, and not the patentability of the process, and that an old or obvious product, whether claimed in "product by process" claims or not. Note that Applicant has the burden of proof in such cases, as the above caselaw makes clear.



In regards to claim 177, Wakabayashi fails to disclose the following:

a) the die includes conductive vias in electrical communication with the die contacts and the contact bumps.

However, Farnworth discloses a semiconductor device that utilizes a plurality of conductive vias (30) in the die electrical communication with contacts (38) (For Example: See Figures 1A-1G and Column 4 Lines 1-4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Wakabayashi to include a plurality of conductive vias as disclosed in Farnworth because it aids in providing electrical communication between the integrated circuit and the contacts (For Example: See Abstract).

Additionally, since Wakabayashi and Farnworth are both from the same field of endeavor, the purpose disclosed by Farnworth would have been recognized in the pertinent art of Wakabayashi.

In regards to claim 178, Wakabayashi discloses the following:

a) the die contacts comprise a bond pads (For Example: See Figure 15).

In regards to claim 263, Wakabayashi fails to disclose the following:

a) the die terminal contacts and the contact bumps having a height selected to provide a desired spacing for flip chip mounting the component.

Wakabayashi discloses the claimed invention except for a semiconductor die having die terminal contacts and the contact bumps having a height selected to provide a desired spacing for flip chip mounting the component. It would have been obvious matter of design choice to provide a semiconductor die having die terminal contacts and the contact bumps having a height selected to provide a desired spacing for flip chip mounting the component, since such a

Art Unit: 2822

modification would have a mere change in the size of a component. A change in size is generally recognized as being within the level of ordinary skill in the art. See *In re Rise*, 105 USPQ 237 (CCPA 1955).

Additionally, the applicant has not established the critical nature of “the die having a selected thickness and the first polymer layer precise thickness and the second polymer layer having a precise thickness.” “The law is replete with cases in which the difference between the claimed invention and the prior art is some range or other variable within the claims. . . . In such a situation, the applicant must show that the particular range is critical, generally by showing that the claimed range achieves unexpected results relative to the prior art range.” *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir.1990).

In regards to claim 265, Wakabayashi discloses the following:

a) the first polymer layer on each edge comprises a portion of a polymer filled trench (For Example: See Figure 5 and Figure 15).

In regards to claim 266, Wakabayashi discloses the following:

a) the edge polymer layers and the back side have a same planar surface (For Example: See Figure 15).

In regards to claim 267, Wakabayashi discloses the following:

a) the edge polymer layers have a selected thickness which is different than a thickness of the first polymer layer (For Example: See Figure 15).

7. Claims 171 and 268 are rejected under 35 U.S.C. 103(a) as obvious over Wakabayashi (U.S. Patent No. 6,607,970) in view of Farnworth et al. (U.S. Patent No. 6,620,731), *Moisture Absorption in No-Flow Underfill Materials and its Effect on Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board* by Ferguson et al and Beffa et al. (U.S. Patent No. 6,233,185).

In regards to claim 171, Wakabayashi fails to disclose the following:

a) the die comprises a tested and burned in die and the component comprises a known good component (KGC).

However, Beffa et al. ("Beffa") discloses a semiconductor device that has a die that comprises a tested and burned in die and the component comprises a known good component (For Example: See Column 1 Lines 9-12). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Wakabayashi to include a die that comprises a tested and burned in die and the component comprises a known good component as disclosed in Beffa because it aids in determining which die is functional (For Example: See Column 1 Lines 30-32).

Additionally, since Wakabayashi and Beffa are both from the same field of endeavor, the purpose disclosed by Beffa would have been recognized in the pertinent art of Wakabayashi.

In regards to claim 268, Wakabayashi fails to disclose the following:

a) the thinned die comprises a tested and burned in die.

However, Beffa discloses a semiconductor device that has a die that comprises a tested and burned in die (For Example: See Column 1 Lines 9-12). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor

of Wakabayashi to include a die that comprises a tested and burned in die as disclosed in Beffa because it aids in determining which die is functional (For Example: See Column 1 Lines 30-32).

Additionally, since Wakabayashi and Beffa are both from the same field of endeavor, the purpose disclosed by Beffa would have been recognized in the pertinent art of Wakabayashi.

8. Claim 176 is rejected under 35 U.S.C. 103(a) as obvious over Wakabayashi (U.S. Patent No. 6,607,970) in view of Farnworth et al. (U.S. Patent No. 6,620,731), *Moisture Absorption in No-Flow Underfill Materials and its Effect on Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board* by Ferguson et al and Farnworth et al. (U.S. Patent No. 6,097,087).

In regards to claim 176, Wakabayashi fails to disclose the following:

a) the terminal contacts arranged in a dense ball grid array.

However, Farnworth discloses a semiconductor device that has terminal contacts in a grid array (For Example: See Column 1 Lines 30-36). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Wakabayashi to include terminal contacts in a grid array as disclosed in Farnworth because it aids in permitting high input/output capability (For Example: See Column 1 Lines 31-37).

Additionally, since Wakabayashi and Farnworth are both from the same field of endeavor, the purpose disclosed by Farnworth would have been recognized in the pertinent art of Wakabayashi.

Art Unit: 2822

9. Claim 262 is rejected under 35 U.S.C. 103(a) as obvious over Wakabayashi (U.S. Patent No. 6,607,970) in view of Farnworth et al. (U.S. Patent No. 6,620,731), *Moisture Absorption in No-Flow Underfill Materials and its Effect on Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board* by Ferguson et al. and Kinsman et al. (U.S. Patent No. 6,717,245).

In regards to claim 262, Wakabayashi fails to disclose the following:

a) the die contacts comprise a solderable metal and the contact bumps comprise solder.

However, Kinsman discloses die contacts that comprise a solderable metal and the contact bumps comprise solder (For Example: See Column 5 Lines 1-13). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Wakabayashi to include die contacts that comprise a solderable metal and the contact bumps comprise solder as disclosed in Kinsman because it aids in providing a connection among the components (For Example: See Column 5 Lines 1-13 and Figure 2).

Additionally, since Wakabayashi and Kinsman are both from the same field of endeavor, the purpose disclosed by Kinsman would have been recognized in the pertinent art of Wakabayashi.

10. Claim 269 is rejected under 35 U.S.C. 103(a) as obvious over Wakabayashi (U.S. Patent No. 6,607,970) in view of Farnworth et al. (U.S. Patent No. 6,620,731), *Moisture Absorption in No-Flow Underfill Materials and its Effect on Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board* by Ferguson et al. and Lin (U.S. Patent No. 5,436,203).

In regards to claim 269, Wakabayashi fails to disclose the following:

a) the thinned die is contained on a semiconductor wafer having a polymer support dam proximate to edges thereof.

However, Lin discloses a semiconductor device that has a polymer dam (40) (For Example: See Figure 4). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Wakabayashi to include a polymer dam as disclosed in Lin because it aids in constraining the flow of the encapsulant (For Example: See Column 4 Lines 66-68).

Additionally, since Wakabayashi and Lin are both from the same field of endeavor, the purpose disclosed by Lin would have been recognized in the pertinent art of Wakabayashi.

11. Claim 271 is rejected under 35 U.S.C. 103(a) as obvious over Wakabayashi (U.S. Patent No. 6,607,970) in view of Farnworth et al. (U.S. Patent No. 6,620,731), *Moisture Absorption in No-Flow Underfill Materials and its Effect on Interfacial Adhesion to Solder Mask Coated FR4 Printed Wiring Board* by Ferguson et al. *Functional and Smart Materials* by Wang.

In regards to claim 271, Wakabayashi fails to disclose the following:

a) the second polymer layer comprises parylene.

However, Wang discloses a semiconductor device that has parylene (For Example: See 4.2.3). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the semiconductor of Wakabayashi to include parylene as disclosed in Wang because it aids in providing high reliability (For Example: See 4.2.3).

Additionally, since Wakabayashi and Wang are both from the same field of endeavor, the purpose disclosed by Wang would have been recognized in the pertinent art of Wakabayashi.

***Conclusion***

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MONICA LEWIS whose telephone number is 571-272-1838. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on 571-272-2429. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300 for regular and after final communications.

/Monica Lewis/  
Primary Examiner, Art Unit 2822

March 14, 2008